Title:	LS on 3GPP 5G System support for integration with IEEE TSN networks
Response to:	-
Release:	Release 16
Work Item:	5GS Enhanced support of Vertical and LAN Services (Vertical_LAN)

Source:	SA WG2
To:	IEEE 802.1 WG

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Attachments: link to 3GPP TS 23.501

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1. Overall Description:

3GPP SA WG2 (SA2) would like to inform the IEEE 802.1 WG that 3GPP is working on adding support in 5G System to integrate with IEEE Time-Sensitive Networking (TSN) networks in support of industrial automation vertical.

3GPP TS 22.104 "Technical Specification Group Services and System Aspects; Service requirements for cyber-physical control applications in vertical domains" describes requirements towards 5G in order to support interconnection with TSN networks.

The architectural extensions to support integration of IEEE TSN networks is documented in 3GPP TS 23.501 "System Architecture for the 5G System", see clauses 4.4.8, 5.27, 5.28. The definitions for the terms DS-TT, NW-TT can be found in TS 23.501 clause 4.4.8.2 and for overall 3GPP 5G System architecture, network functions such as gNB, UPF can be found in TS 23.501 in clauses 4.2.1, 4.2.2 and clause 6.

3GPP has chosen to support the following:

- 5G System (5GS) is integrated with the external network as a logical TSN bridge.
- Among the three TSN configuration models defined in IEEE 802.1Qcc , fully centralized model is supported in this release of the specification.
- 5G System features support TSC and allow the 5G System to be integrated transparently as a logical bridge in an IEEE TSN network.
- In Release 16 only supports interworking with TSN using IEEE 802.1Qbv based QoS scheduling.
- In Release 16, only simplified traffic scheduling as described in IEEE 802.1Q Annex Q.2 ("Using gate operations to create protected windows") is supported.
- Support Time Synchronisation following:
    - For TSN Synchronization, the entire E2E 5G System can be considered as an IEEE 802.1AS "time-aware system".
    - Only the TSN Translators (TTs) at the edges of the 5G System (within NW-TT and DS-TT) need to support the IEEE 802.1AS operations.
    - UE, gNB, UPF, NW-TT and DS- TTs are synchronized with the 5G GM (i.e. the 5G internal system clock) which shall serve to keep these network elements synchronized.
- Time Sensitive Communication (TSC) traffic classes are supported with corresponding 5G QoS profiles.
- Support for 5GS logical bridge management functions.

Additionally, 3GPP specifications TS 23.502 and TS 23.503 documents the 5G System procedures and policy framework, based on 3GPP 5G System specification TS 23.501.

During the development of this feature, 3GPP SA2 has encountered some issues and would like to get some feedback:

Issue 1: The CNC configures the scheduling per egress port of bridge based on the IEEE 802.1Qbv.

> The 5GS bridge is on a per UPF (NW-TT) basis on the network side and each UPF can support multiple ports for multiple UEs (with DS-TT on UE side). For each 5GS logical bridge, the ports on NW-TT support the connectivity to the TSN network and they could be associated to multiple PDU Sessions. Every port on DS-TT side provide connectivity to the TSN network and is associated to a unique PDU Session. When the CNC configures the 5GS bridge, the 5GS correlates the configuration information to PDU session(s) to enable resource reservation in the 5GS (e.g. resource reservation in the NG-RAN).
> > For the Downlink TSN traffic (i.e. egress port in DS-TT side), the 5GS can use the egress port to identify an unique PDU session.
> > But for the Uplink traffic, when there are multiple PDU Sessions mapped to a given port in the UPF (NW-TT) side, the 5GS can't use the egress port (i.e. port on UPF side) to identify related PDU session(s) because all the PDU sessions could share a port on the UPF side.

> There is no restriction on the number of ports that a UPF (NW-TT) may have, and each PDU Session could be mapped one-to-one to a port within UPF. In this case a port identifier could be used to uniquely identify the 5GS PDU Session on the uplink. In the absence of one-to-one mapping, SA2 requests if the CNC can provide the ingress port information in addition to egress port in the configuration to facilitate identification of unique PDU Session in the uplink?

> Note that a PDU session is defined as: "Association between the UE and a Data Network that provides a PDU connectivity service. The type of PDU Session which can be IPv4, IPv6, IPv4v6, Ethernet or Unstructured."

Issue 2: Mapping IEEE 802.1Qbv parameters for use in the 5GS QoS for enabling efficient scheduling in the 5GS when multiple TSN streams are multiplexed in the same QoS Flow.

> IEEE 802.1Qcc defines a TrafficSpecification group and an optional TSpecTimeAware group that specifies how the Talker transmits frames on per TSN stream basis. IEEE 802.1Qcc Annex U describes three examples of TSN stream scheduling by the Talker, ranging from per traffic class scheduling (Annex U.1.1) to per TSN stream scheduling (Annex U.1.3).

> In contrast, IEEE 802.1Qbv seems to support only per traffic class scheduling at the bridge egress port.
> It is SA2 understanding that a Traffic Class in IEEE 802.1Qcc and QoS Flow in 5GS have the same QoS granularity in that all packets of a Traffic Class or of a QoS Flow receive the same QoS treatment.

> > If the 5GS (in the role of TSN logical bridge) could be configured with QoS information with TSN stream granularity, the 5GS may be able to provide efficient air-interface scheduling on per TSN stream basis, even when multiple TSN streams are multiplexed in the same QoS Flow.

> SA2 would like to understand whether IEEE has any plans to enhance IEEE 802.1Q specification such that TSN stream scheduling in the TSN bridge is supported.

2. Actions:

To IEEE 802.1 WG

ACTION:
SA WG2 kindly requests comments/feedback on the overall approach, if any.
In addition, SA2 seeks any feedback and guidance IEEE 802.1 WG may provide on the above-mentioned issues/questions.

3. Next TSG SA2 Meetings:

SA WG2 Meeting #135	14 - 18 October, 2019	Split, Croatia
SA WG2 Meeting #136	18 – 22 November, 2019	Reno, NV, USA